

and 2A. NRPs can be used to create the equivalent of a tiered structure, or they can be used to create other structures of nodes. Fig. 3A shows a Web Server Pool and a Data Server Pool. An Application Server Pool, or other, user defined pool, can be created and labeled. Any number of pools can be defined.

[71] Fig. 3B illustrates a user interface where a user has added specific nodes to the defined NRPs. Nodes can be added by selecting them individually from an existing domain, or by providing specific internet protocol (IP) addresses. A preferred embodiment of the invention uses nodes that follow standard internet conventions such as machine, or IP, addresses. However, other embodiments may use other protocols, standards, etc., to define nodes. Node names can be generic, as shown in Fig. 3B, or they can be given unique names by a user, or assigned automatically. Naturally, any number and type of node can be assigned to a pool. The pool/node hierarchy is displayed and manipulated much like a familiar file management system.

[72] Fig. 3C illustrates the representation of intelligence objects (IOs). IOs are defined and associated with nodes. Two types of IOs are provided in a preferred embodiment. These are the System Level Object (SLO) and Transaction Level Object (TLO). Each IO is typically identified by the icon to the left of the descriptive text. The icon is placed adjacent to a node in which, or to which, the IO corresponds. During operation, the IO gathers information on the operation and resource use of components at the node.

[73] SLOs can be grouped into pools. The preferred embodiment provides two types of pools as (1) Functional Resource Pools to organize SLOs for nodes that support a common application so that nodes with like functionality are grouped; and (2) Node Resource Pools for organizing FRPs and SLOs for nodes that provide a common service. Links between pools and nodes indicate where functional relationships exist. NRPs and FRPs link together to provide system process flow and to define sub networks for optimization calculations.

[74] Fig. 3D illustrates organizing of nodes in NRPs into Functional Resource Pools.

[75] Once NRPs have been created and nodes assigned, the NRPs can be further subdivided into Functional Resource Pools (FRPs). The FRPs provide a refinement of node function by allowing nodes to be grouped according to specific roles assigned to the FRPs (i.e., Managerial Login servers, Staff Login servers, etc). One or more FRPs can be created inside a NRP, as shown in Fig. 3D. In a preferred embodiment, only SLO and TLO nodes can belong to an FRP.

[76] Fig. 3E illustrates establishing connectivity and data flow among NRPs, FRPs and nodes.

[77] An important step in configuring a network involves determining the route that transactions will take when they move through the system. Routes are determined by the way pools and nodes are linked together. There are three different levels at which links can be defined, as follows:

- a. Node Resource Pool to Node Resource Pool
- b. Functional Resource Pool to Functional Resource Pool
- c. Node to Node

[78] In a DASPO network, NRPs represent the lowest level of detail and nodes represent the highest level. Connections made at higher levels of detail will override the connections made at lower levels. Linking also has certain important implications. For example, if two NRPs are linked, the inference is made that every FRP and every node within the two pools is connected, as shown in Fig. 3E.

[79] Network management is simplified by allowing connections to be made at different levels. Initial connections can be made quickly and simply when establishing an initial network transaction process flow since higher level connections automatically define lower-level connections. For example, a pool-to-pool connection automatically defines lower FRP and node connections with respect to FRPs and nodes within the connected pools. As more network fine-tuning becomes necessary, a refinement of the initial set of links, at a more detailed level, is possible (i.e. node-to-node).

[80] Defining network connections results in the creation of DASPO subnetworks. A DASPO subnetwork is a specific relationship defined between nodes that are linked together across Functional Resource Pools. Subnetworks can, but need not, have a correlation to the physical or logical network organization. For example, subnetworks can follow the multi-tiered design discussed above where each of three subnetworks corresponds to web, application and database tiers. The concept of subnetworking allows a user to flexibly define transaction flows across a network when calculating ideal system optimization.

[81] Fig. 3F illustrates a connection made between FRP 1 and FRP 2. This creates a subnetwork among nodes associated with the FRPs. A subnetwork exists from the "A" node as shown in Fig. 3G. The "A" subnetwork includes nodes B and C from FRP 2.

[82] When nodes are grouped together in Functional Resource Pools, their SLOs and TLOs communicate Local Node Value (LNV) and other intelligence object information to each other. As a result of this communication, each node is aware of the value of every other node in its FRP and, if queried, can identify the Best Node. The Best Node is defined as the server within a particular FRP that is able to handle a system transaction with the greatest efficiency at a given moment. A detailed description of value formats, value passing, composite values and other uses of values can be found in related patent application (3), cited above.

[83] From the LNV of a first node, and from the LNVs of other nodes related to the first node in a subnetwork, a Composite Node Value (CNV) is calculated. A preferred embodiment of the invention uses normalized weights to rank the contribution of the LNV and CNV of every node in the subnetwork associated with the first node. The preferred embodiment takes network latency into account to modify passed CNV and/or LNV values when the values are passed to different nodes.

[84] One feature of a preferred embodiment is that the nodes gather data in the form of CNVs and LNVs and the data is accumulated by a central console, or computer system, operable or accessible to a human user for monitoring and control. This approach allows a administrator to monitor, log, analyze, adjust and optimize separate aspects of a network system. Past, recent and current performance of the network is provided. The network can be automatically instructed by the console (or another system or process) to act in accordance with measured parameters (e.g., based on the CNV and LNV data) to redirect data transfers to the best available resources, nodes, or other components. This approach of distributed, hierarchical, peer-to-peer value gathering to a central console provides efficient and accurate system management.

[85] When DASPO subnetworks are created, an FRP process has information on the best node to utilize at any point in time. The "best node" may not necessarily be the least utilized node. By providing a global view of system performance, an FRP process can determine nodes which, if routed to, would provide overall system performance improvement. Similarly, an FRP is aware of best nodes for routing or other utilization in the FRP's subnetwork, allowing for faster rerouting decisions and improved resource utilization.

[86] Fig. 3H illustrates a screen shot of a user interface display to allow a user to set-up a DASPO.

[87] In Fig. 3H, the features discussed above are shown, including the use of pools, FRPs and SLOs interconnected to form subnetworks. Area 120 is used to set up